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UNIVERSITY OF ALBERTA
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REDWING
A New Seed Flax for Alberta

BY

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I.—INTRODUCTION.

Due to a steady yearly reduction in the Canadian flax acreage and production, Canada is rapidly transforming herself from a major flax seed exporting country into one which fails to produce enough, even for her own needs. In 1920, Canada seeded more than 1,400,000 acres to flax and harvested a crop of 8,000,000 bushels. Approximately 2½ million bushels of this amount were exported to the United States. Out of 9¼ million bushels produced in 1925, 6 million were exported to the United States, an amount equalling 39% of the flax requirements of that country. In 1933, Canada seeded 243,000 acres of flax, harvested a crop of 625,000 bushels and exported half a million bushels, or 4% of the United States' requirements for that year. For this same year Canada imported 325,000 bushels of flax from Argentine and India.

Approximately 90% of the flax produced in Canada is grown in the prairie provinces. The flax seed acreage in this area has varied greatly in the past twenty years. The peak occurred in the pre-war years 1911-1914, when the acreage varied from 1,078,000 to 2,012,000 acres. The large acreage at this time reflected the agricultural expansion that had occurred, which resulted in the breaking of new land and the use of flax as a pioneer crop. The pre-war peak was reached again in 1918, 1919, 1920, and in 1924. From 1925 to the present time, the flax seed acreage has trended downwards, reaching the lowest level in over 20 years in 1933, when 235,900 acres were sown. The Dominion Bureau of Statistics estimates that Canadian crushing plants require about two million bushels of flax seed annually, or about three times the amount produced in the years 1933 and 1934. This does not take into account the quantities that are, or could be used, for grinding and feeding purposes on the farm, and which do not enter the trade.

A number of factors have contributed to the decreasing acreage sown to flax and to the consequent diminution of exports. The popularity of flax during the years of early settlement was due to its ability to yield a good crop the same year that new land was broken, and thus give the farmer an immediate cash return. With the subsequent decrease of new breaking, flax acreage has been steadily reduced. As the land under cultivation became older and the weed problem increased, the popularity of flax decreased because of the inability of flax to compete successfully with weeds in old or dirty land. The gradual increase in tariff rates on flax seed going into the United States has seriously affected the movement of Canadian flax into that country. The United States was formerly the largest importer of Canadian flax seed. Until recent years the price of flax has been such as to make it an unprofitable crop to grow. It has been estimated that when the price of flax is 1.75 times that of wheat, an increase in acreage of flax sown occurs the following spring. So long as the price ratio remains below this figure a decrease in acreage occurs. In 1931-32 and 1932-33 the prices of flax were 1.71 and 1.51 times that of wheat respectively, and decreases in acreage sown followed. In 1933-34, and at the present time, the price of flax is over twice that of wheat. This would indicate that flax has a relatively higher value than wheat at the present time.

II.—ADVANTAGES OF GROWING FLAX.

For the past five years, flax has given on the average comparatively higher returns per acre to the producer than has wheat. A crop of flax can be handled with the same machinery as that used for wheat, so there is no additional cost in its production (Figure 1). Since linseed oil is the primary constituent of paints, any revival of business from the present depression should be reflected directly in the demand for flax seed.

Flax is a very desirable crop to use in rotations, since it is not attacked by the same disease organisms that affect the cereals. This is especially true of organisms causing foot-rots. It is also of advantage in rotations to the registered seed grower of cereals, since there is very little danger of carrying over any admixtures to the succeeding crops.

Flax may be grown also to advantage following the use of chemical weed eradicators. Cereal crops cannot be grown satisfactorily until these chemicals have been leached down

out of the zones normally occupied by their roots. Flax, having a shallow root system, may be grown to advantage at an earlier date than most cereals.

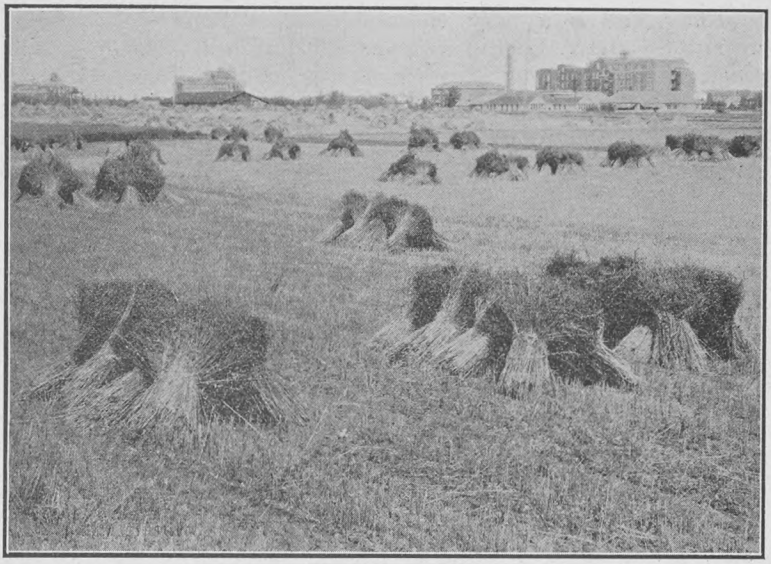

Figure 1.—Redwing flax grown on stubble (rate of seeding, 30 lbs. per acre), showing the manner of harvesting. University of Alberta, Edmonton, 1934.

Many farmers hesitate to grow flax because of the common belief that it is hard on the soil. Careful experimentation has shown that flax is not harder on the soil than any of the cereal crops. This opinion has probably arisen from the poor results obtained from a crop succeeding flax which has been grown on breaking. Any crop on breaking in most years uses up so much of the soil moisture, which would have ordinarily assisted in decomposing the sod or fresh vegetable matter, that any succeeding crop is very likely to be a poor one. From the point of view of water utilization, flax is more economical than most field crops commonly grown in western Canada. The shallow root-system of this plant, in contrast to those of the small grains, allows for a greater storage of subsoil moisture and carry-over into the next growing season. If flax is grown on summer-fallowed land it would then be desirable to follow it with wheat, oats or barley.

The poor competing efficiency of flax is of advantage when the crop is used as a nurse crop for legumes or grasses. The latter are able to get an early start in the spring and are not

unduly impeded in growth by shading. Furthermore, the flax does not exhaust the available soil moisture to the same extent as the cereals and consequently leaves a greater supply for the grasses.

Flax seed is a very valuable protein feed with a high nutritive value. Owing to the fact that it has been grown chiefly as a source of linseed oil, its use as a livestock food has not been as general as its feeding value would warrant. Flax seed could be fed to advantage on many more farms than it is at the present time.*

Owing to its high fat and oil content, flax seed is credited with practically 100% total digestible nutrients. It is unsurpassed as a protein supplement for feeding calves, when fed at the rate of approximately half a pound per day. For yearling or fattening cattle flax seed, when mixed with the grain ration at the rate of ½ to 1¼ pounds per day will maintain the animals in a thrifty condition and put bloom on the fur. As a supplemental feed for horses, flax seed is excellent. The addition of about two to three ounces of ground flax to the oat ration will rapidly restore bloom. Small amounts of flax seed, not exceeding 5% of the ration, are also beneficial when feeding pigs.

Flax may be fed also in the form of linseed oil meal or oil cake, which is the residue of the flax seed after the oil has been extracted. Linseed oil meal is considered to be one of the most healthful concentrates that can be fed to livestock. The following extract has been taken from the work of a well known authority on livestock feeds: "There is no more healthful food for limited use with all farm animals than linseed oil cake or oil meal, with its rich store of crude protein, slightly laxative oil, and its mucilaginous soothing properties. Its judicious use is soon apparent on the pliable skin, the sleek oily coat and the good handling quality of the flesh of animals receiving it."

A large proportion of the flax acreage in western Canada has been located in the southern, or drier, portions of the prairie provinces, where the growing season is longer than in the north. This appears to be due in part to the long growth period of the varieties commonly grown and the practice of late seeding. It is now well known that early seeding is preferable to late seeding on clean land. In the meantime earlier maturing varieties have been produced which will mature successfully in most years in the central and north

*Notes on feeding value from a summary by D. Cameron, Department of Extension, University of Alberta.

central part of the province. These factors are causing a shift of the flax acreage to the north, which will be very desirable from the standpoint of stabilizing the production of flax and diversifying further the crops in a region where moisture is not as important a limiting factor in most years, as it is in the dry area. Recent reports from the laboratories of the Board of Grain Commissioners on the quality of flax grown in various parts of the prairie provinces state, that the higher quality flax is produced in those regions where moisture is more favorable. The situation appears to be practically the reverse of that with wheat, where the drier regions favor the development of high quality bread wheat.

Experiments were started in 1929, at the University of Alberta, to obtain a flax variety that would be suitable in the central and north central parts of the province. Numerous new varieties were tested, together with the old varieties commonly grown in this region. The results of six years' tests demonstrated rather conclusively that the variety known as Redwing was the most suitable for this area. This circular has been written with the object of acquainting the flax grower with the more important agronomic characters of Redwing flax.

III.—ORIGIN.

Redwing was developed at the Minnesota Agricultural Experiment Station, St. Paul, in a co-operative breeding program between the Divisions of Plant Pathology and Genetics. The senior author of the present paper assisted in that work. It originated from single plant and bulk selections made in 1914-15-16, from a strain known as Accession No. 91. The latter had been obtained from the United States Department of Agriculture. Redwing was introduced into Alberta by the University in 1929.

IV.—DESCRIPTION.

Redwing belongs to the group of small-seeded oil flaxes which are characterized, in general, by small funnel-shaped flowers, semi-dehiscent bolls, medium length of straw, and medium maturity. The flowers of Redwing are a characteristic pale blue color. The seeds are brown and the septa (the walls separating the seeds within the boll) are fringed with fine hairs.

V.—EXPERIMENTAL RESULTS.

Agronomic data for Redwing have been compiled for yield, earliness of maturity, strength of straw, height of plant, weight per bushel, oil content, quality of oil and disease reaction. Comparable data for five other varieties, possessing more than average yielding ability, have been included for purposes of comparison. N.D. 114 and Crown have been grown in western Canada for a considerable length of time; while Bison, Buda and Linota are relatively recent introductions.

1.—Yield.

The yield data of the six varieties for the four-year period 1931-34, have been summarized in Table I. It will be noted that the average yields have also been expressed as a percentage of Redwing. These data show Redwing to have a very satisfactory yielding capacity. In the four-year average it yielded practically on a par with Linota, and excelled Bison, Buda and N.D. 114 in this regard. Crown averaged approximately one bushel more than Redwing.

TABLE I.

Comparative yearly (1931-34) and average yields of Redwing and five other varieties of flax when grown at Edmonton

Variety	1931	1932	1933	1934	Average	Aver. yield in per cent of Redwing
Bison	22.3	7.5	23.2	16.1	17.3	84.4
Buda	25.5	7.3	25.6	18.8	19.3	94.1
Crown	28.1	7.3	30.0	21.5	21.7	105.9
Linota	29.8	6.6	25.7	21.3	20.9	102.0
N.D. 114	23.8	7.6	21.5	21.2	18.5	90.2
Redwing	25.0	9.5	24.4	22.9	20.5	100.0

2.—Earliness of maturity.

The question of earliness of flax varieties intended for central and northern parts of Alberta cannot be over-emphasized. The growth period of a flax variety grown in any given district should not be longer than that of spring wheat in the same district. Furthermore, flax should be sown as soon after spring wheat as possible. It has been the practice to sow flax late because of the necessity of eradicating weeds before seeding the flax. This has led to the common belief that late spring frosts are of greater danger to flax, and consequently it should be sown late. If the seed bed is properly prepared, the danger of injury from frost is no greater in the case of flax than in the case of the small grains. Most of the newer varieties are more resistant to frost than the older ones and can withstand light frosts without serious injury. Figure 2 shows the effect of different degrees of frost on the survival of the plants of different varieties. Note the high survival after 12 degrees of frost.

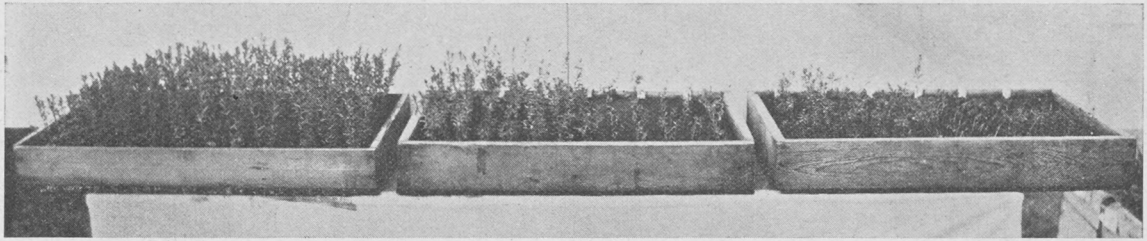

Fig. 2.—Six flax varieties frozen artificially at 25 deg. F., 20 deg. F., and 15 deg. F. (left to right) for two hours.

Redwing is the earliest maturing of the six varieties listed in Table II. It averaged one day earlier than N.D. 114, four days earlier than Linota, and fully a week earlier than Bison, Buda or Crown. The importance of early maturity in a flax variety intended for central and northern Alberta, is brought out forcibly when it is considered that the average growth period of Marquis wheat at the University farm, for the past six years, has been 107 days, or equal to that of Redwing. It becomes evident, therefore, that varieties like Bison and Crown, which require over a week longer to mature than Redwing, are distinctly too late to be grown successfully in the northern parts of Alberta.

TABLE II.

Comparative yearly (1931-34) and average growth periods of Redwing and five other varieties of flax when grown at Edmonton

Variety	Growth period in days					
	1931	1932	1933	1934	Average	Days later than Redwing
Bison	125	93	124	117	115	8
Buda	124	93	122	117	114	7
Crown	127	94	123	117	115	8
Linota	121	89	120	115	111	4
N.D. 114	118	85	119	110	108	1
Redwing	118	86	114	108	107	0

3.—Strength of straw.

A good strength of straw is an important characteristic of a suitable flax variety. It is very difficult to harvest a badly lodged field of flax with ordinary harvesting machinery.

Considerable lodging of flax occurred on the University farm in 1931 and 1932, conditions being especially severe in 1932. Little or no lodging occurred in 1933 or 1934. For this reason the data given in Table III pertain to the years 1931 and 1932 only. It will be seen that when lodging is a factor, Redwing and N.D. 114 have a definite advantage over the other four varieties. Redwing shows an average of 6% and N.D. 114 an average of 7% lodging for the two-year period, while comparable percentages for Buda, Bison, Linota and Crown were 10, 17, 22 and 22, respectively. The strong straw of Redwing is well illustrated in Figure 3, which shows a field of this variety grown on summer-fallowed land at Edmonton in 1934.

4.—Height of plant.

There is considerably more importance attached to length of straw in a flax variety than there is in the case of cereal

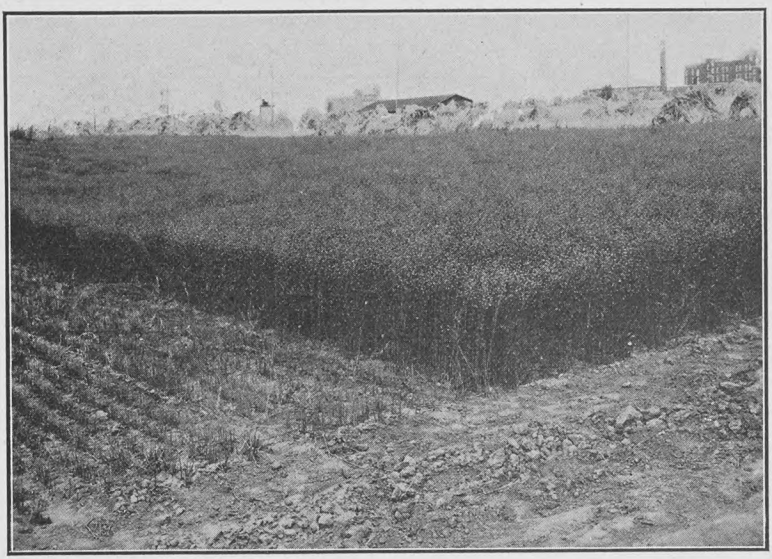

Figure 3.—A field of Redwing flax grown on summer-fallowed land at the University of Alberta, Edmonton, in 1934.

TABLE III.

Comparative yearly (1931-32) and average lodging of Redwing and five other varieties of flax when grown at Edmonton.

Variety	Lodging in per cent.		
	1931	1932	Average
Bison	11	23	17
Buda	3	16	10
Crown	8	35	22
Linota	0	43	22
N.D. 114	2	13	7
Redwing	0	12	6

varieties. This is due to the fact that flax is characteristically shorter strawed than the cereals. The longer-strawed flax varieties are not only easier to harvest than the shorter ones, but they are in a much better position to compete with weeds. Redwing possesses a satisfactory length of straw (see Table IV). This variety averaged 26 inches in height for the four-year period 1931-34, as compared with 27 inches in the cases of Bison, N.D. 114, Crown and Linota; and 28 inches in the case of Buda.

TABLE IV.

Comparative yearly (1931-34) and average height of Redwing and five other varieties of flax, when grown at Edmonton.

Variety	Height in inches					
	1931	1932	1933	1934	Average	Inches taller than Redwing
Bison	27	26	23	30	27	1
Buda	28	27	24	31	28	2
Crown	26	27	23	30	27	1
Linota	28	26	23	29	27	1
N.D. 114	28	27	24	30	27	1
Redwing	28	26	23	28	26	0

5.—Weight per bushel.

The data summarized in Table V show Redwing to compare favorably with the other five varieties with regard to weight per bushel.

TABLE V.

Comparative yearly (1933-34) and average weights per bushel of Redwing and five other varieties of flax when grown at Edmonton.

Variety	Weight per bushel in pounds		
	1933	1934	Average
Bison	52.0	52.0	52.0
Buda	54.0	53.0	53.5
Crown	53.5	54.5	54.0
Linota	53.5	55.5	54.5
N.D. 114	54.5	55.0	55.0
Redwing	54.0	53.5	54.0

6.—Oil content and quality of oil.

Generally speaking, the greater part of the flax seed crop produced in Canada is destined for the production of linseed oil, which is used extensively in the production of paints, varnish, linoleum, oilcloth, etc. For this reason it is desirable that a flax variety produce a large quantity of high-quality oil. The yield and quality of the oil has been found to vary according to percentage of water in the seed and the amount of immature, musty and otherwise damaged seed. Flax varieties vary, however, with regard to the quantity and quality of oil they produce. Under laboratory conditions the quality of a given sample of oil is measured by determining the iodine number. A high iodine number denotes high quality. Data pertaining to oil content and iodine numbers are given in Table VI. The oil yield of Redwing, on a three-year average, compares favorably with that of the other varieties. The quality of oil produced by Bison and Crown is inferior to that produced by Redwing. Hence, in brief, it may be said that Redwing produces a satisfactory percentage of oil of excellent quality.

TABLE VI.

Comparative yearly (1932-34) and average oil yields and iodine numbers of Redwing and four other varieties of flax when grown at Edmonton.

Variety	Oil yield in per cent.				Iodine number			
	1932	1933	1934	Average	1932	1933	1934	Average
Bison	36.9	38.4	39.2	38.2	180	183	189	184
Crown	36.8	38.7	38.1	37.9	182	189	195	187
Linota	33.7	36.2	36.2	35.4	188	192	198	193
N.D. 114	33.9	35.9	37.4	35.7	189	194	198	194
Redwing	34.2	36.2	37.6	36.0	186	192	196	191

In 1934, four varieties, Redwing, Bison, N.D. 114 and Crown, were grown on the gray wooded soils at Fallis. Their performance under these conditions was compared with the results obtained with the same varieties on black soil at Edmonton. The yields were lower at Fallis than at Edmonton, but both the quantity and quality of oil were higher. This observation is in agreement with the statement made earlier that a higher quality of flax seed can be expected from those regions, such as central and northern Alberta, where moisture conditions are more favorable.

The superiority of Redwing over Bison for the northern gray soil area is well illustrated in Figure 4. Bison was weak-strawed, very poor in vigor and low in yield. Redwing was stiff-strawed, had a vigorous growth, and was the highest yielding of the four varieties tested. In some years, Bison reacts in a similar manner on the black soil at Edmonton, to that shown at Fallis.

7.—Disease reaction.

The two most destructive diseases of the flax crop occurring in America are wilt and rust. These diseases, while present in Alberta, are not of great economic importance as yet. It is quite possible, when flax is grown more extensively in western Canada than it is at present, that these diseases (particularly wilt) will become of much greater importance.

In common with a number of the newer introductions, such as Bison, Buda and Linota, Redwing is resistant to wilt and partially resistant to rust. N.D. 114 is resistant to wilt, but susceptible to rust; while Crown is very susceptible to both diseases. It has been already noted (Table I) that at Edmonton, where wilt is not a limiting factor, a susceptible variety like Crown gives very satisfactory results. Data compiled at other stations, however, where wilt is quite prevalent, show Crown to be considerably more reduced in yield than the

Figure 4.—Comparative growth habits of Bison (3 rows at the left) and Redwing (3 rows at the right) when grown on the gray wooded soil at Fallis in 1934. Note the spreading habit of Bison as contrasted to the strong upright growth of Redwing.

resistant types, such as Redwing and Bison. The growing of disease resistant flax varieties will tend, not only to reduce the cost of production, but also to stabilize production.

VI.—SUMMARY.

The production of flax seed in Canada has steadily decreased until, at the present time, Canada is on an import basis. The scarcity of new breaking, the increasing weed problem, the high import duties imposed by the United States, coupled with a decline in price, have been responsible to a large extent for the present situation.

With the price of flax at the present time approximately twice that of wheat, the outlook for the flax producer is good. Furthermore, any revival of the building industry will cause an increased demand for linseed oil which, in turn, should increase the demand for flax seed.

There are several advantages in addition to the relatively high price to be accrued from growing flax. In the first place flax has been found to be a desirable crop to include in rotations as it is not subject to the same diseases as the cereals. Furthermore, due to its shallow rooting system, flax allows for a greater carry-over of subsoil moisture into the next growing season. This is of advantage when flax is followed by the deeper-rooted cereals, wheat, barley or oats.

Flax has been reported also to make a good nurse crop for legumes and grasses, and is one of the best crops to follow the use of chemical weed eradicators.

Flax is high in protein and has a high nutritive value when fed in limited amounts to almost any class of livestock. Flax seed, or linseed meal, could be fed to advantage on many more farms than it is at the present time.

One of the important limiting factors in flax production in central and northern Alberta is the short growing season. Hence it is not only important to grow early varieties, but these should be seeded as early as wheat, or soon thereafter.

Redwing has been the earliest of the higher yielding, small-seeded varieties tested at the University of Alberta. It possesses a stiff straw, is of average height, and shows a satisfactory weight per bushel. Furthermore, it yields a good quantity of high quality oil. Redwing is also resistant to the destructive wilt disease, and is partially resistant to rust.

Redwing should tend to displace a number of the older, later-maturing, disease-susceptible varieties now being grown.

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